

**REMARKS****RESTRICTION**

The Office required restriction to:

- I. Claims 1-23, drawn to a microfabricated Bragg waveguide, or
- II. Claims 24-43, drawn to a method of fabricating a microfabricated Bragg waveguide.

Applicants elect Group I, claims 1-23, drawn to a microfabricated Bragg waveguide, without traverse.

**STATUS OF THE CLAIMS**

Claims 1-23 and 44-47 remain in the application.

The Office rejected claims 1-10 and 12-22 under 35 U.S.C. § 102(e) as being anticipated by *Huber*.

The Office rejected claims 1-10 and 12-22 under 35 U.S.C. § 103(a) as being obvious over *Huber* in view of *Laakmann*.

The Office rejected claims 11 and 23 under 35 U.S.C. § 103(a) as being unpatentable over *Huber*.

Applicants have amended Claims 1 and 12 to recite an embedded waveguide or hollow tube having a continuous conformal inner multilayer dielectric cladding. Support for these amendments are found in the Application at page 12, lines 24-31, page 15, lines 6-10, page 17, lines 10-17, and FIGs. 3-6.

Applicants have amended claim 13 to provide proper antecedent basis.

Applicants have cancelled claims 24-43.

Applicants have added new claims 44-47.

**SUMMARY OF THE INVENTION**

The present invention is directed to a microfabricated Bragg waveguide comprising a continuous conformal coverage of multilayer dielectric cladding on the inner wall of a closed trench embedded in a substrate or a free-standing tube. The Bragg waveguide can be fabricated of

semiconductor-compatible materials, such as silicon, silicon dioxide, and silicon nitride. The layer thicknesses of the multilayer dielectric cladding can be selected to have a first cladding layer of slightly below the half-wave thickness to provide minimum radiation loss for linearly polarized light.

#### SUMMARY OF THE ART

*Huber et al.*, U.S. Patent Application No. US2003/0035613 A1, discloses a hollow waveguide based optical switch. The waveguide can have a metallic or seamed multilayer dielectric coating. The Application discloses a method for fabricating the waveguide in an open core, comprising depositing the reflective coating in the open core, filling the core with a sacrificial material, planarizing the sacrificial material, and depositing a separate reflective coating on the planarized sacrificial material.

*Lackmann et al.*, U.S. 4,688,893, discloses a hollow waveguide having inner reflective layer comprising plural layers of dielectric. Preferably, the inner dielectric layers have quarter wave thickness.

## ARGUMENTS

AMENDED CLAIMS 1 -10 AND 12-22, LIMITED TO A CLOSED TRENCH OR TUBE HAVING A CONTINUOUS MULTILAYER DIELECTRIC COATING DEPOSITED CONFORMABLY ON THE INNER WALL OF THE HOLLOW CORE, ARE NOT ANTICIPATED BY HUBER UNDER 35 U.S.C. § 102(e)

The Office rejected claims 1-10 and 12-22, asserting that the Applicants' waveguide is anticipated by *Huber*'s optical device. To anticipate a claim, the reference must teach each and every element of the claim. *See MPEP 2131*. Applicants submit that *Huber* does not anticipate claims 1-10 and 12-22, because *Huber* does not teach an embedded waveguide or hollow fiber having a continuous multilayer dielectric coating deposited conformably on the inner wall of the hollow core.

*Huber* only teaches a waveguide having a reflective dielectric coating fabricated in an open core of a bottom wafer and a separate reflective layer fabricated on the top of the open core. In particular, *Huber*'s reflective dielectric coating is fabricated in the open core before the core is filled with a sacrificial material that is planarized to leave a planar wafer surface on which a conductive-reflective element can then be coated with a separate reflective layer. Therefore, *Huber*'s reflective dielectric coating cannot be a continuous, uniform conformal coating on the inner wall of the core and would necessarily be lossy at the discontinuities between the separately fabricated reflective coatings. *See Huber*, Paragraphs 42-43 and FIG. 7a-h.

In contrast, Applicants teach, and amended claims 1 and 12 recite, an embedded closed trench or hollow tube having a continuous multilayer dielectric coating that is conformally deposited on the inner wall of the hollow core of the closed trench or hollow tube. *See Application* at page 12, lines 24-31, page 15, lines 6-10, page 17, lines 10-17, and FIGs. 3-6. Nowhere does *Huber* teach or suggest an embedded waveguide or hollow tube having a continuous conformal multilayer dielectric coating on the inner wall. Accordingly, Applicants submit that this rejection is overcome and that amended claims 1 and 12 are in condition for allowance. Furthermore, Applicants submit that claims 2-11 and claims 13-23, which depend from and further define claims 1 and 12, respectively, are likewise in condition for allowance. *See MPEP 2143.03*.

AMENDED CLAIMS 1 -10 AND 12-22, LIMITED TO A CLOSED TRENCH OR TUBE HAVING A  
CONTINUOUS MULTILAYER DIELECTRIC COATING DEPOSITED CONFORMABLY ON THE INNER  
WALL OF THE HOLLOW CORE, ARE NOT OBVIOUS OVER HUBER IN VIEW OF LAAKMAN UNDER 35  
U.S.C. § 103(a)

The Office rejected claims 1-10 and 12-22, asserting that the Applicants' waveguide is obvious over *Huber*'s optical device in view of *Laakman*'s teaching of a multilayer dielectric cladding. To establish a *prima facie* case of obviousness, *inter alia*, the prior art references must teach or suggest all the claim limitations and there must be a suggestion or motivation to modify the reference. *See MPEP § 2143*. Applicants submit that claims 1-10 and 12-22 are not obvious over *Huber* in view of *Laakmann*, because neither *Huber* nor *Laakmann*, alone or in combination, teach or suggest an embedded waveguide or hollow fiber having an inner continuous conformal multilayer dielectric coating, nor do the references teach or suggest a means to modify *Huber*'s optical device or fabrication process to enable such a waveguide or fiber.

Applicants have argued, *supra*, that *Huber* does not teach or suggest the limitation of a uniform conformal multilayer dielectric coating on the inside of an embedded waveguide or hollow fiber of semiconductor-compatible materials. Nor does *Laakmann* teach or suggest such a limitation. Accordingly, Applicants submit that claims 1 and 12 are in condition for allowance. Furthermore, Applicants submit that claims 2-11 and 13-23, which depend from and further define claims 1 and 12, respectively, are likewise in condition for allowance. *See MPEP 2143.03*.

AMENDED CLAIMS 11 AND 23, LIMITED TO A TRENCH OR TUBE HAVING A UNIFORM CONFORMAL  
MULTILAYER DIELECTRIC COATING DISPOSED ON THE INNER WALL, ARE NOT UNPATENTABLE  
OVER HUBER UNDER 35 U.S.C. § 103(a)

The Office rejected claims 11 and 13, asserting that the Applicants' waveguide having a core filled with a high refractive index material is obvious in view of *Huber*'s optical device. Applicants have argued, *supra*, that *Huber* does not teach or suggest the limitation of a continuous conformal multilayer dielectric coating on the inside of an embedded waveguide or hollow fiber of semiconductor-compatible materials and that claims 1 and 12 are in condition for allowance. Applicants submit that claims 11 and 23, which depend from and further define claims 1 and 12, respectively, are likewise in condition for allowance. *See MPEP 2143.03*.

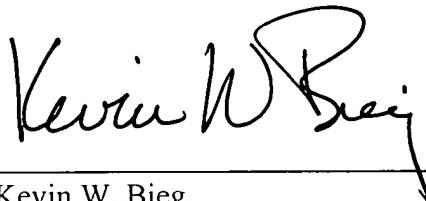
NEW CLAIMS 44-47

Applicants have added new claims 44-47, to recite multilayer dielectric claddings that are optimized to propagate linearly polarized light. Support for these new claims is found in the Application at page 9, lines 7, through page 10, line 18. Prior waveguides, comprising a quarter wave stack, have been optimized to propagate TE modes with low loss. *See Yeh et al., J. Opt. Soc. Am.* 68(9) 1196 (1978); *Fink et al., Science* 282, 1679 (1998); and U.S. Patent No. 4,688,893 to Lackmann. However, these TE-mode-optimized stack designs can be very lossy for the TM modes of linearly polarized light propagating in the waveguide. In contrast, Applicants' waveguide optimizes the stack design to propagate both modes with relatively low losses. In particular, Applicants' stack has a first cladding layer slightly below the half-wave thickness.

CONCLUSION

Applicants have amended the claims and urge that the application is now in condition for allowance.

Respectfully submitted,




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CERTIFICATION UNDER 37 CFR 1.8

I hereby certify that this correspondence and documents referred to herein were deposited with the United States Postal Service as first class mail addressed to: Commissioner for Patents, Alexandria, VA 22313-1450 on the date shown below.

Date: 10/14/51

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